REMARKS

Claim 1 has been amended. Claims 1-13 remain in the application. Reexamination and reconsideration of the application, as amended, are respectfully requested.

Applicants note with appreciation the Examiner's allowance of claims 9-13.

Claims 1-3 and 5-8 were rejected under 35 U.S.C. 103(a) as being unpatentable over Seo in view of Garcia. Claim 4 was rejected under 35 U.S.C. 103(a) as being unpatentable over Seo in view of Garcia further in view of Bloom.

These rejections are respectfully traversed.

<u>First</u>, applicants note that allowed claims 9-13 and rejected claims 1-8 are not directed to "independent and distinct inventions." See 37 CFR 1.141. Allowed claims 9-13 and rejected claims 1-8 are related as method and system for implementing method, respectively.

Method claims 9-13 are allowed because neither Seo nor Garcia disclose or suggest a method comprising:

> "the step of optically correlating comprising configuring at least a one-dimensional optical correlator to produce an output comprising a multi-dimensional output array having a first dimension and a second dimension, the first dimension associated with a hypothesis and the second dimension associated with a correlation result,"

Applicants respectfully submit that claims 1-8, which define a system for implementing the method of claims 9-13, are allowable for at least the same reason. Applicants respectfully submit that neither Seo nor Garcia disclose or suggest a system comprising:

> "a one-dimensional optical correlator configured to produce an output comprising a multi-dimensional output array having a first dimension and a second dimension, the first dimension associated with a hypothesis and the second dimension associated with a correlation result"

The language recited in allowed claims 9-13 and rejected claims 1-8 is nearly identical. Seo and Garcia fail to disclose or suggest the step of configuring an optical correlator as defined

by claims 9-13. Applicants submit that these references must therefore necessarily fail to disclose or suggest the optical correlator as identically defined by claims 1-8.

Second, applicants respectfully submit that the proposed combination of Seo and Garcia would not have been obvious to a person of ordinary skill in the art. Specifically, applicants submit that a skilled person would not have found it obvious to remove the correlators of Seo and replace them with the optical correlators of Garcia, as proposed.

The Garcia correlator mainly addresses the need for rapid change of reference signal. A reference signal (leading to a set of spots 74 on spatial light modulator 16) is generated by sampling a hologram library of signals. A particular reference signal is selected by rapid steering of a light steering device. However, one skilled in the art would not use the Garcia device with the Seo multi-user detection system for at least the following reasons.

At any given time, the Garcia correlator has only one input (26), one reference (20), and one output (from 18). Garcia fails to teach or suggest how to correlate the input signal with many reference signals, simultaneously. Garcia fails to teach or suggest a plurality of beams 46 (2D Bragg beam steerer) to produce a plurality of reference signals 20 to focus onto a plurality of photodetectors (18). That is, in Garcia Figure 2, there is only a single column of spots 74_1, 74_2, …, 74_N. A skilled person would be discouraged from extending the functionality to multiple simultaneous references (multiple columns), since the reference illuminator (40) would be spread (diluted) over the number of simultaneous beams generated and the corresponding signal would be prohibitively weak.

Despite this teaching against the combination, if one attempted to use the Garcia correlator (Garcia 10) in place of the Seo correlator (CO_1, I_1, and SW_1 of Seo 10), then a plurality of Garcia correlators would be needed to create Seo's matched filter (Seo 10). However, this is not practical for at least several reasons. Most importantly, the main economy of the Garcia optical correlator is the ability to simultaneously "correspond" (correlate) many signal rays (22_1, 22_2, …, 22_N) with many reference rays (20_1, 20_2, …, 20_N). To duplicate the Garcia optical correlator for many simultaneous reference signals would be prohibitively expensive. All components (e.g., lasers, beam steerers, holograms, etc) would need to be duplicated and thus result in a bulky, power hungry system as well.

There are other reasons why the Garcia optical correlator, independently, would not be selected by, much less obvious to, one skilled in the art. The reference signals are stored in a hologram library. In many applications, new signals need to be accommodated. As presented

by Garcia, the hologram is not dynamic and new or modified reference signals are not accommodated by the Garcia correlator. Mechanically replacing the hologram is tedious and may not be possible depending on where the correlator is deployed (e.g., in a satellite). The type of hologram needed by Garcia may not be modifiable. Certainly Garcia does not teach or suggest a means to modify or update the hologram.

The correlation interval (designated as "T" in Seo and in the present application) is not highlighted by Garcia, but it is evidently determined by the length of the sampling pulse utilized by the Signal Sampler (30). For any given optical pulse source, the pulse width of an optical pulse train does not have a wide range of control and typically would not extend to long pulse widths needed for a wider variety of systems (e.g., a cellular telephone system could have longer correlation times than an electronic warfare signal). Furthermore, the sampling interval or "interpulse time" is not dynamically modifiable in the sense that the mandrel diameter and the star coupler fiber lengths determine the sampling interval and cannot be easily changed why the system is in operation. In contrast, in the present invention the correlator's sampling interval is determined electronically by controlling the charge integration time and charge transport.

With the Garcia correlator, the optical signals 24_1, 24_2, ..., 24_N from the spatial light modulator images 74_1, 74_2, ..., 74_N are merged into beam 88 by focusing lens 86 (column 6, lines 50-53). This technique of overlaying the beams of the optical signals to create a summation is problematic. It is known in the art that, for acceptable system noise performance, the input light signal 26 must result from the modulation of a highly coherent source or laser. However, overlaying beams that emanate from the same source within its coherence time will result in interference effects. That is, the arrival time (optical phase) of each of the optical signals must be strictly controlled to avoid destructive interference between optical signals. As such the diameter of the mandrel 50, each individual length of fiber on the mandrel, or the length of fiber in each arm of the star coupler 60 must be held at particular lengths to within a fraction of a wavelength of light. Namely all the lengths of fiber must be held to a specified value with a tolerance of less than a few nanometers. This is very difficult due to the thermal expansion of the fiber.

In summary, a skilled person would not have found it obvious to remove the correlators of Seo and replace them with the optical correlators of Garcia for at least the following reasons: 1) not able to only accommodate more than one correlation at a time, 2) not easily adapted to accommodate multiple simultaneous signals, 3) replicating to form a plurality is bulky and

costly, 4) not able to readily change the reference library, 5) difficulty in controlling the correlation interval time or sampling interval, and most importantly, 6) it appears that due to coherence effects, the Garcia correlator may not operate at all.

Third, claim 1 has been amended to recite a combination including an optical processor comprising a one-dimensional optical correlator configured to produce an output comprising a multi-dimensional output array having a first dimension and a second dimension, the first dimension associated with a correlation of an input with different hypotheses and the second dimension associated with sliding correlation results at sub-intervals of a correlation interval.

Support for the term "correlation of input with different hypothesis" can be found, for example, as a correlation with all of H_j, including all time slots $H_j(t_1)$, $H_j(t_2)$, …, $H_j(t_{N'})$ in Figure 6. An example of a "correlation of input with different hypothesis" can also be seen in Equation (3) in that there are M correlations associated with M hypotheses.

Support for the term "sliding correlation results at sub-intervals of the correlation interval with a given hypothesis" may be found, for example, as inputs 82 in Figure 9, "Set of Hypothesis loaded into SLM" in Figure 14, and inputs 82 in Figure 15. Further support may be found, for example, in the phrase "m^{th} hypothesis, H_m, at the nth time offset, τ_n, …" from paragraph 0070 which refers to variable H_m $(t-\tau_n)$ in Equation (5), and in the phrase "the array of hypothesis elements H_m (t_n)" in paragraph 0108. The concept is also supported in paragraph 0109 which states "Furthermore, from Equation (8), for each successive time $T+\Delta\tau$, the time delay τ increases by $\Delta\tau$, therefore the time series output of $D_{m,N}$ is correlation of successive time delays of the received waveform relative to the hypothesis H_m." In addition, paragraph 0067 contains the phrase "$r(\tau)$ is the measured correlation at a particular time offset τ. To measure the correlation as a function of time offsets, the measurement as given in Equation (1) may be made for a set of N τ's producing a set, or vector, of N correlation values designated $C_n(\tau_n)$." These statements explain the "dimension" of time offset. Equation (3) shows one example of 2 of the dimensions covered by claim 1. In this example m (ranging from 1 to M) corresponds to the correlation of the input with different hypotheses dimension and n (ranging from 1 to N) corresponds to the time offset or sliding correlation results at sub-intervals of the correlation interval dimension. Hence, the 2-dimensional matrix $C_{m,n}$. In this embodiment the correlations are not performed serially but rather in parallel and as a function of time offset, thus producing a sliding correlation with time. The word "sliding" is intended to convey the disclosed concept of parallel simultaneous calculations.

A combination including an optical processor comprising a one-dimensional optical correlator configured to produce an output comprising a multi-dimensional output array having a first dimension and a second dimension, the first dimension associated with a correlation of an input with different hypotheses and the second dimension associated with sliding correlation results at sub-intervals of a correlation interval is not disclosed or suggested in Seo or Garcia.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue. If it is determined that a telephone conference would expedite the prosecution of this application, the Examiner is invited to telephone the undersigned at the number given below.

In the event the U.S. Patent and Trademark office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to Deposit Account No. 03-1952 referencing docket no. 509622000400.

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